



# Announcing the RX62T Group for Motor Control, the Third Release of Products in the RX Family

March 3, 2010

**Renesas Technology Corp.**

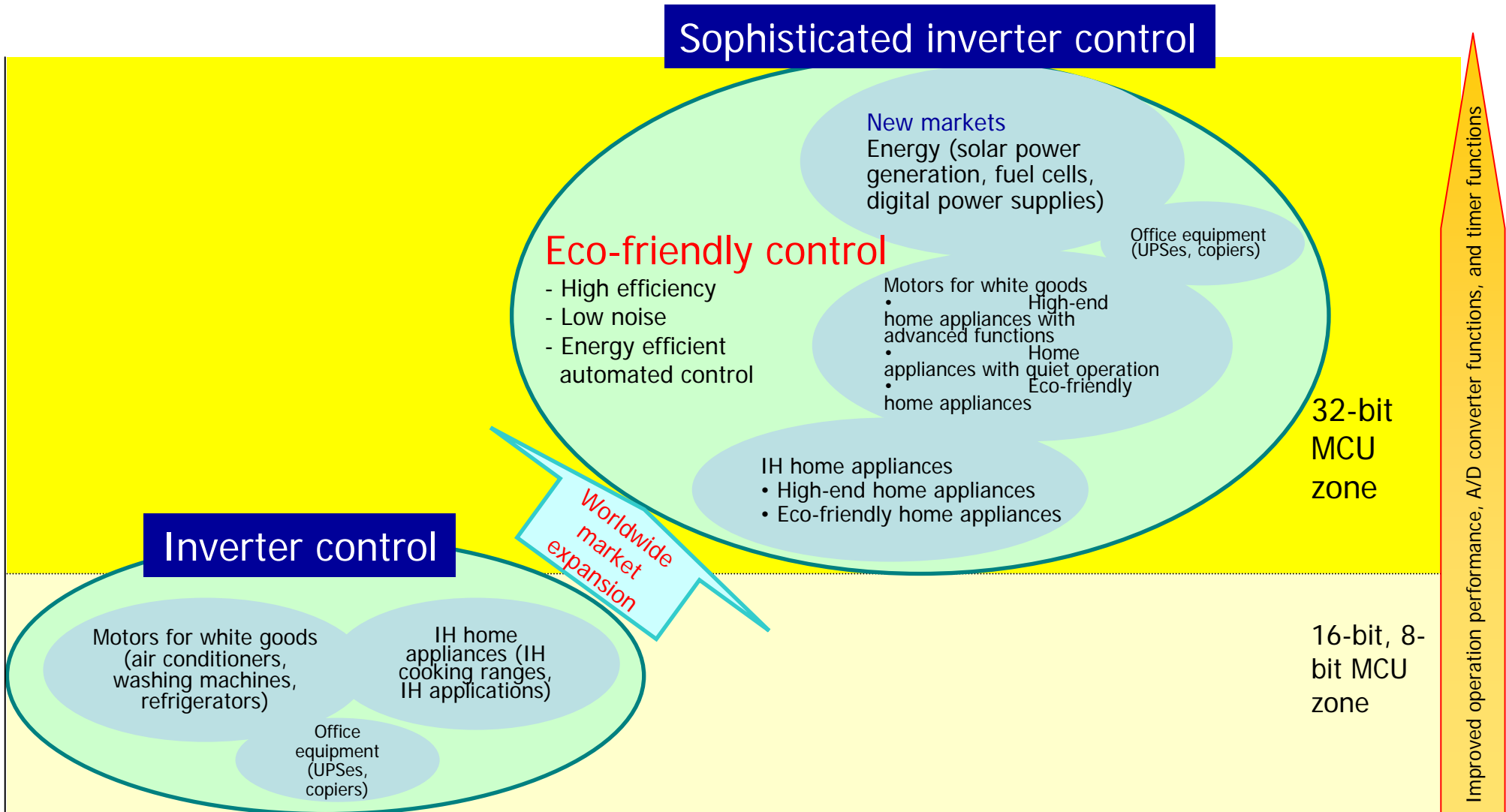


- **RX62T Development Background**
- RX62T Features
  - A/D Converters with Enhanced Functionality
  - High-Speed, High-Performance RX CPU
  - Timers with Enhanced Functionality
  - Other Features and Overview of Specifications
- Summary

# Advances in Inverter Control and Expansion of the Market



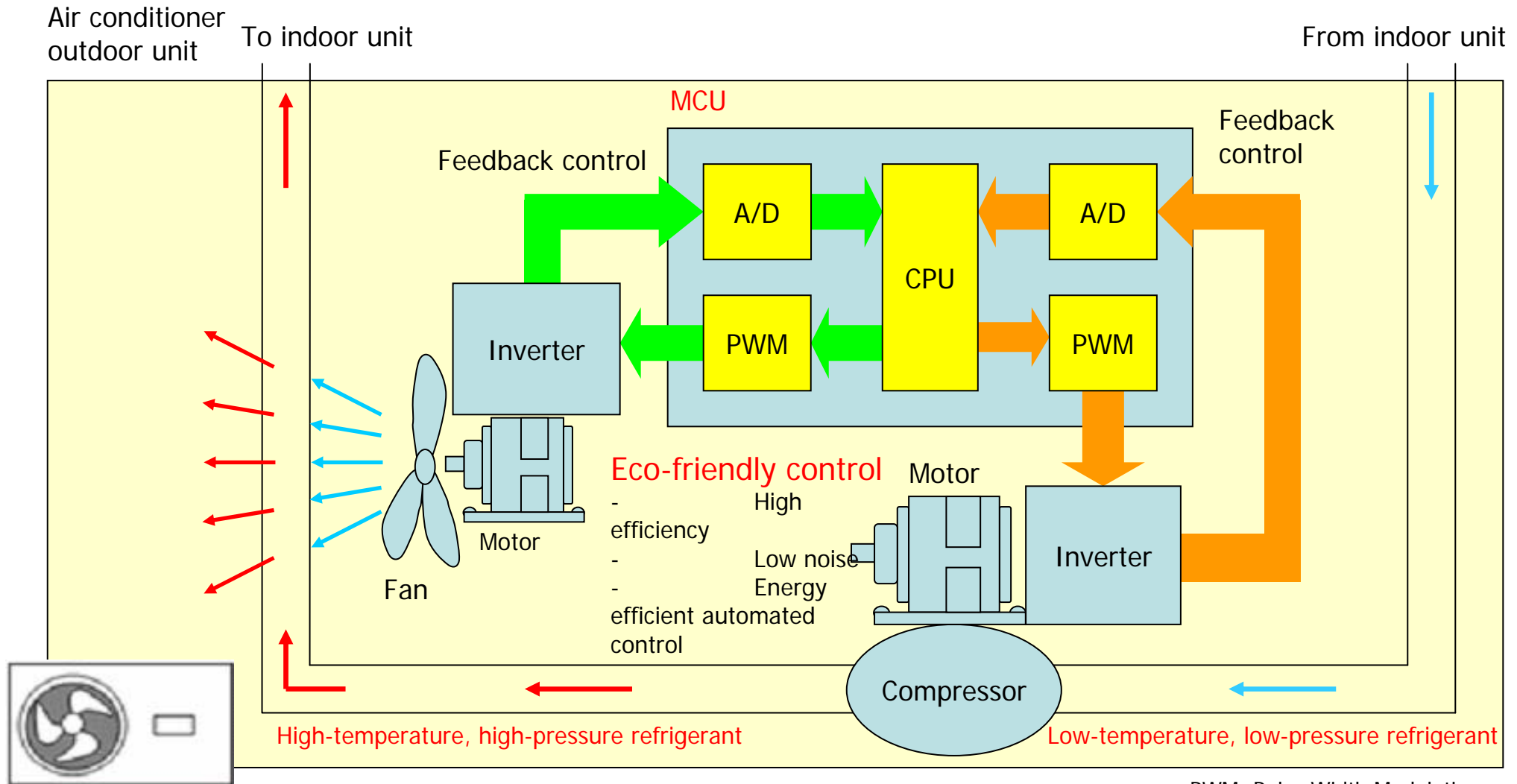
- The market is expanding for products incorporating sophisticated inverter control for high performance and eco-friendliness.



# Inverter Control Application Example (Air Conditioner Outdoor Unit)



- Eco-friendly performance requires compact feedback control that is accurate and responsive.

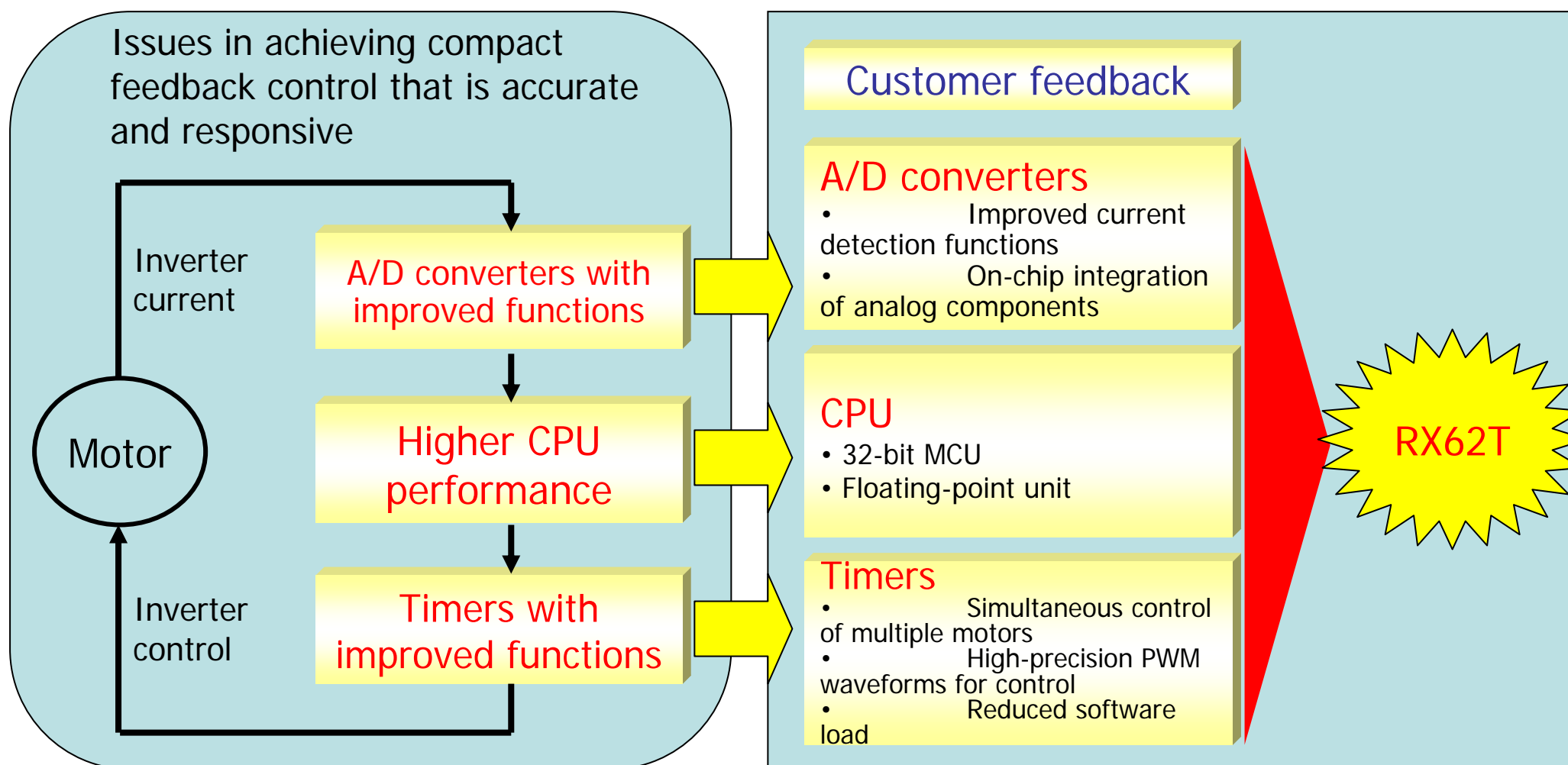


PWM: Pulse Width Modulation

# Renesas Solutions in Response to Customer Feedback



■ The RX62T provides improved feedback control functions for the inverter market.



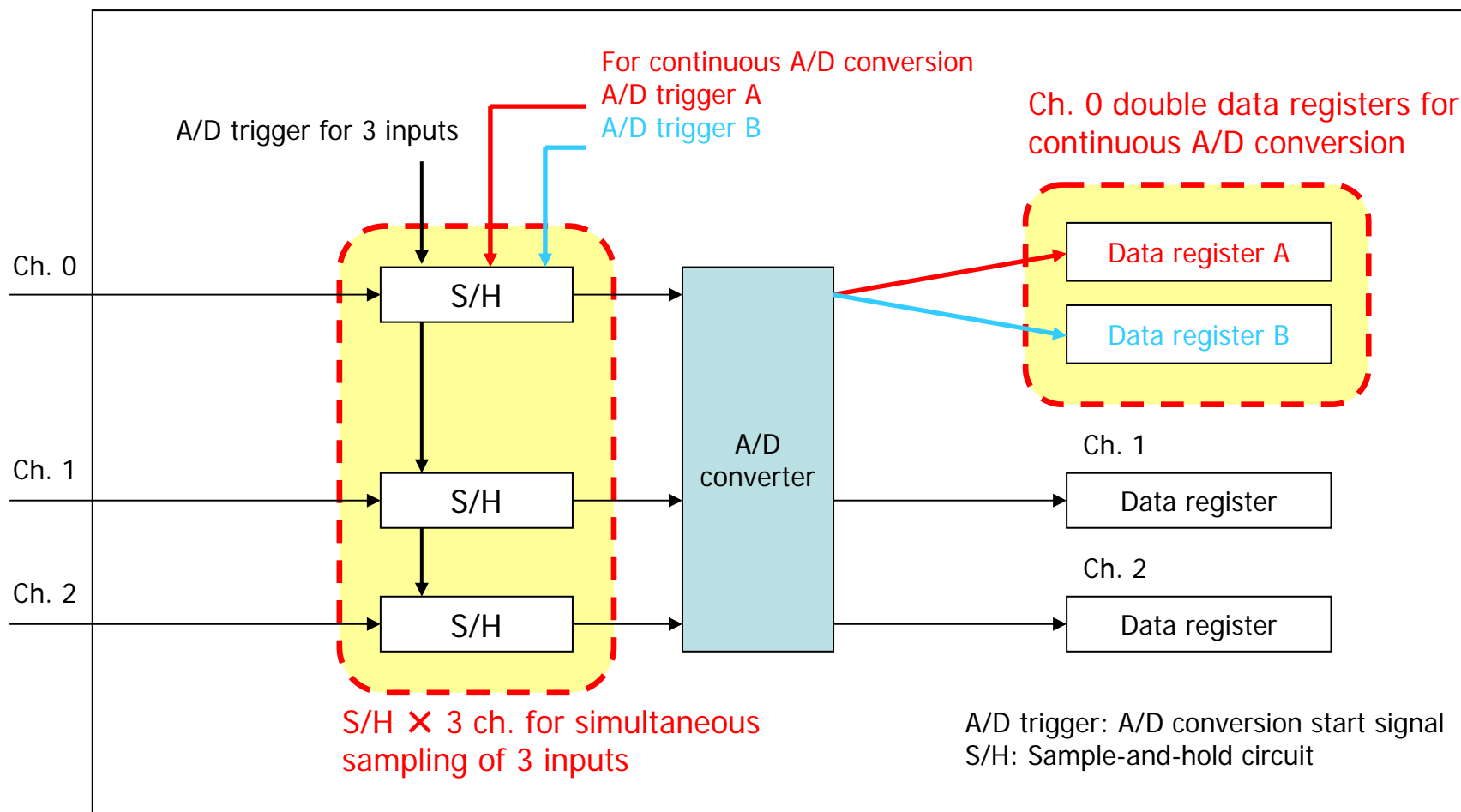
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# A/D Converters with Enhanced Functionality: Improved Current Detection Functions



- The 12-bit A/D converter provides easy current detection.  
⇒ Enables highly accurate and responsive feedback control.

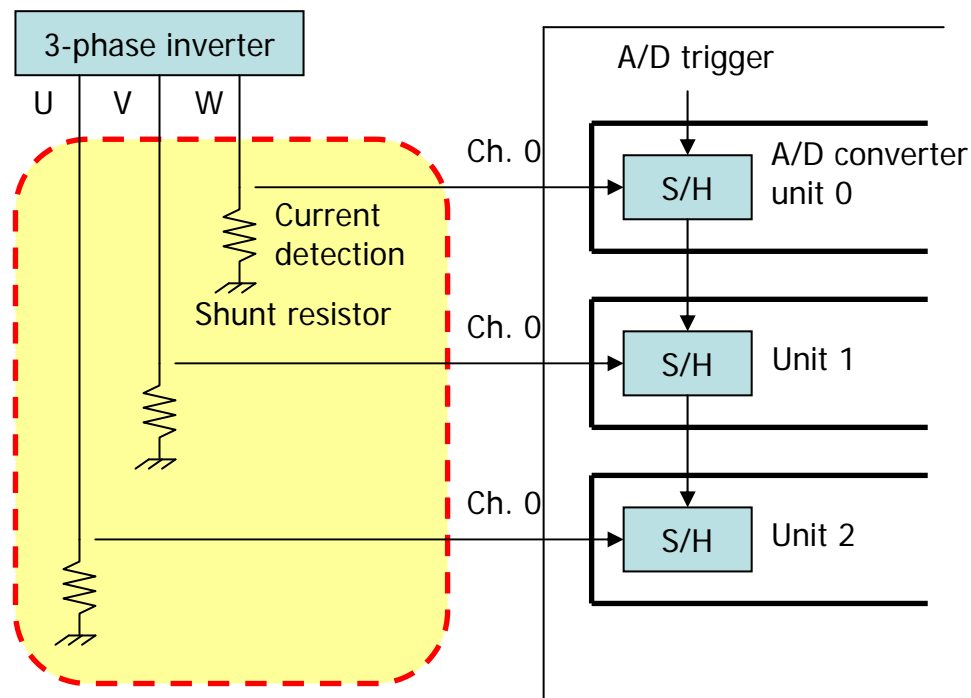
12-bit A/D converter (unit 0, unit 1)



# A/D Converters with Enhanced Functionality: Effect of Three-Channel Sample-and-Hold Circuit

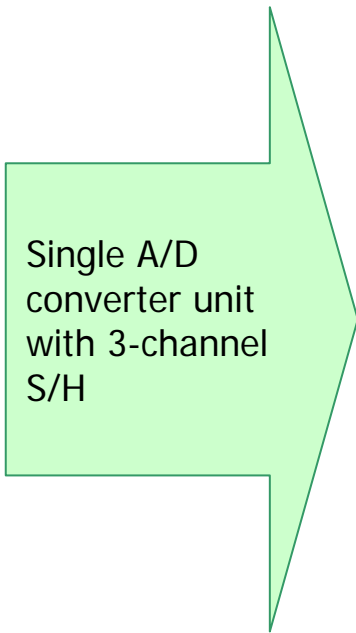
- Simultaneous sampling by one A/D converter unit of currents from three shunt resistors  
 ⇒ Easy implementation of 3-shunt control

Earlier product: Three A/D converter units used for simultaneous sampling of three inputs

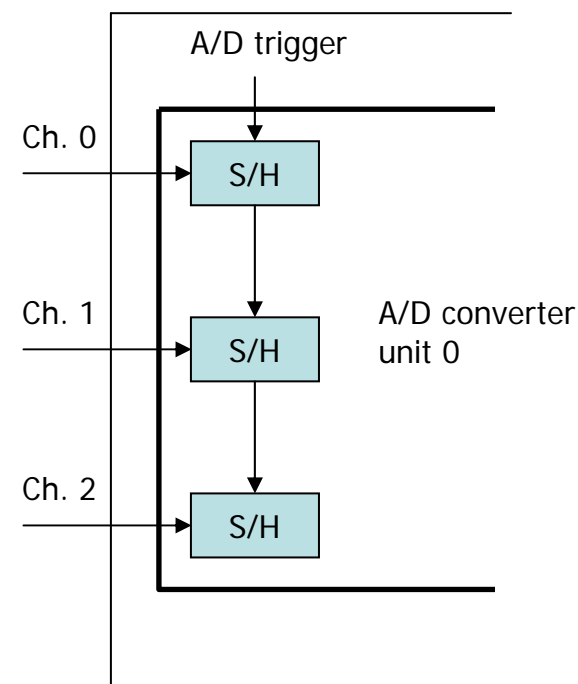


3-shunt control

Simultaneous sampling of U, V, and W phase currents



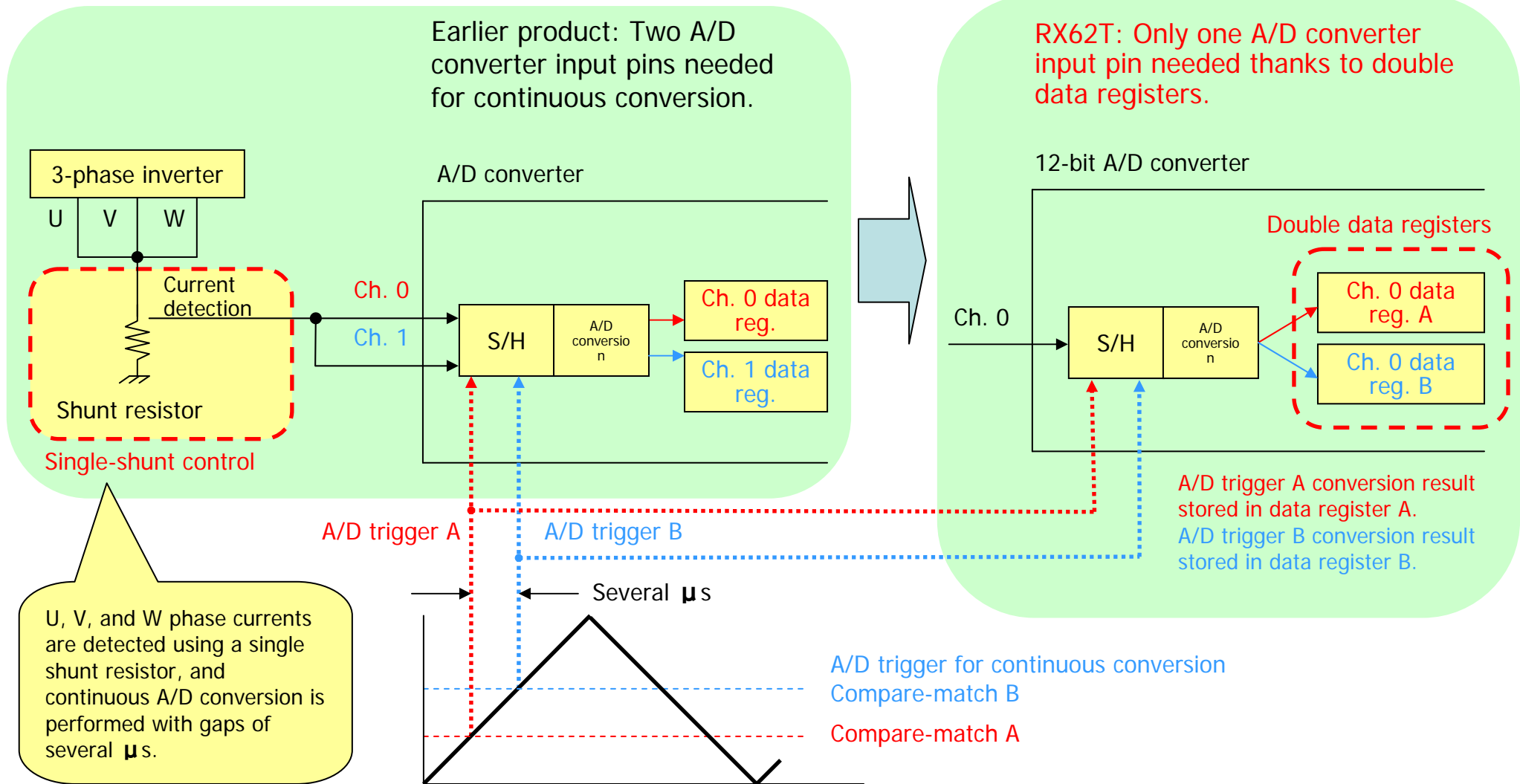
RX62T: S/H × 3 ch. enabling use of single A/D converter unit



A/D trigger: A/D conversion start signal  
 S/H: Sample-and-hold circuit

# A/D Converters with Enhanced Functionality: Effect of Double Data Registers

- Continuous sampling of one shunt resistor current via single A/D converter input pin  
 ⇒ Effective pin utilization for single-shunt control



# A/D Converters with Enhanced Functionality: Shunt Control Application Example Using RX62T

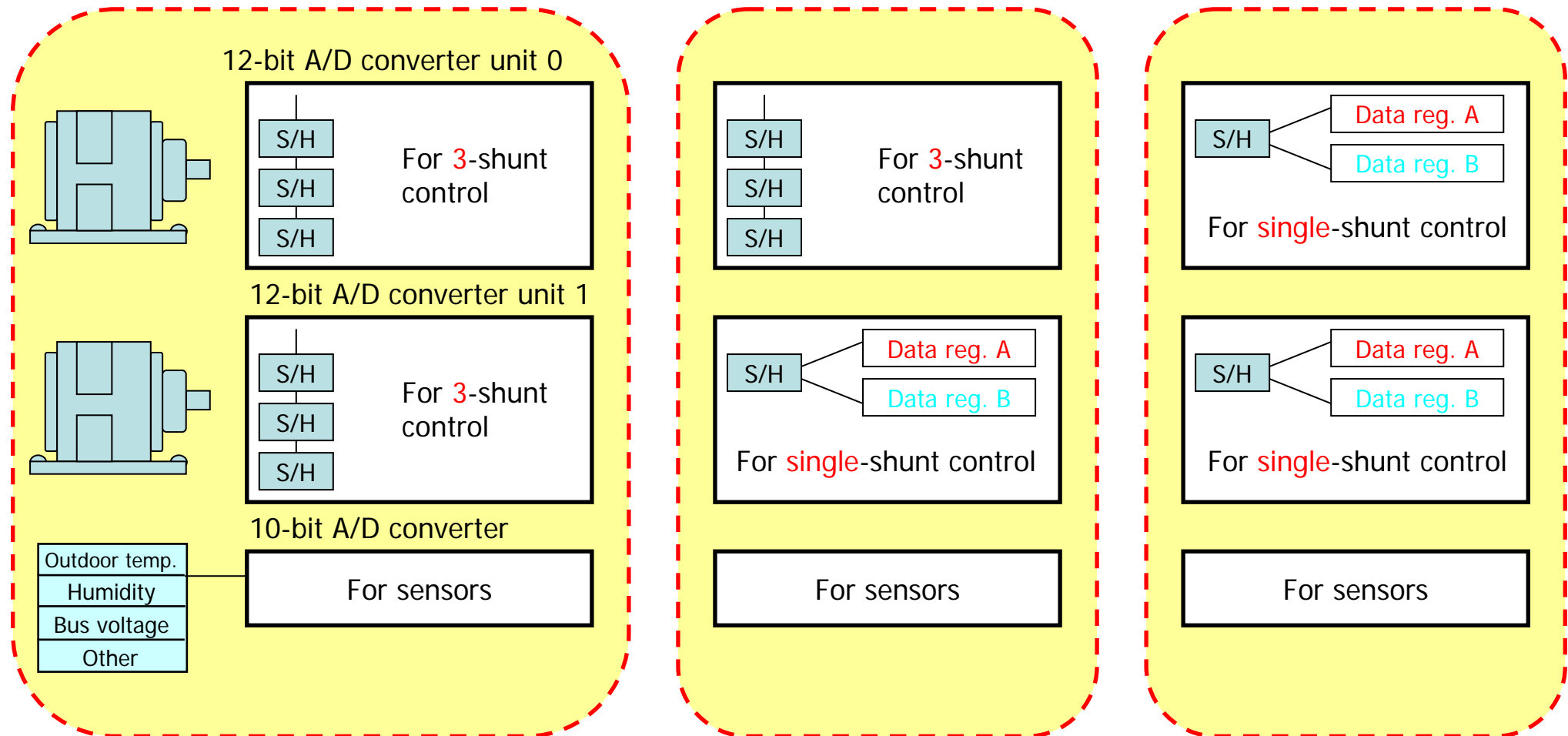


- Offering optimal solutions to match the control requirements of customers

Control using the RX62T Case 1

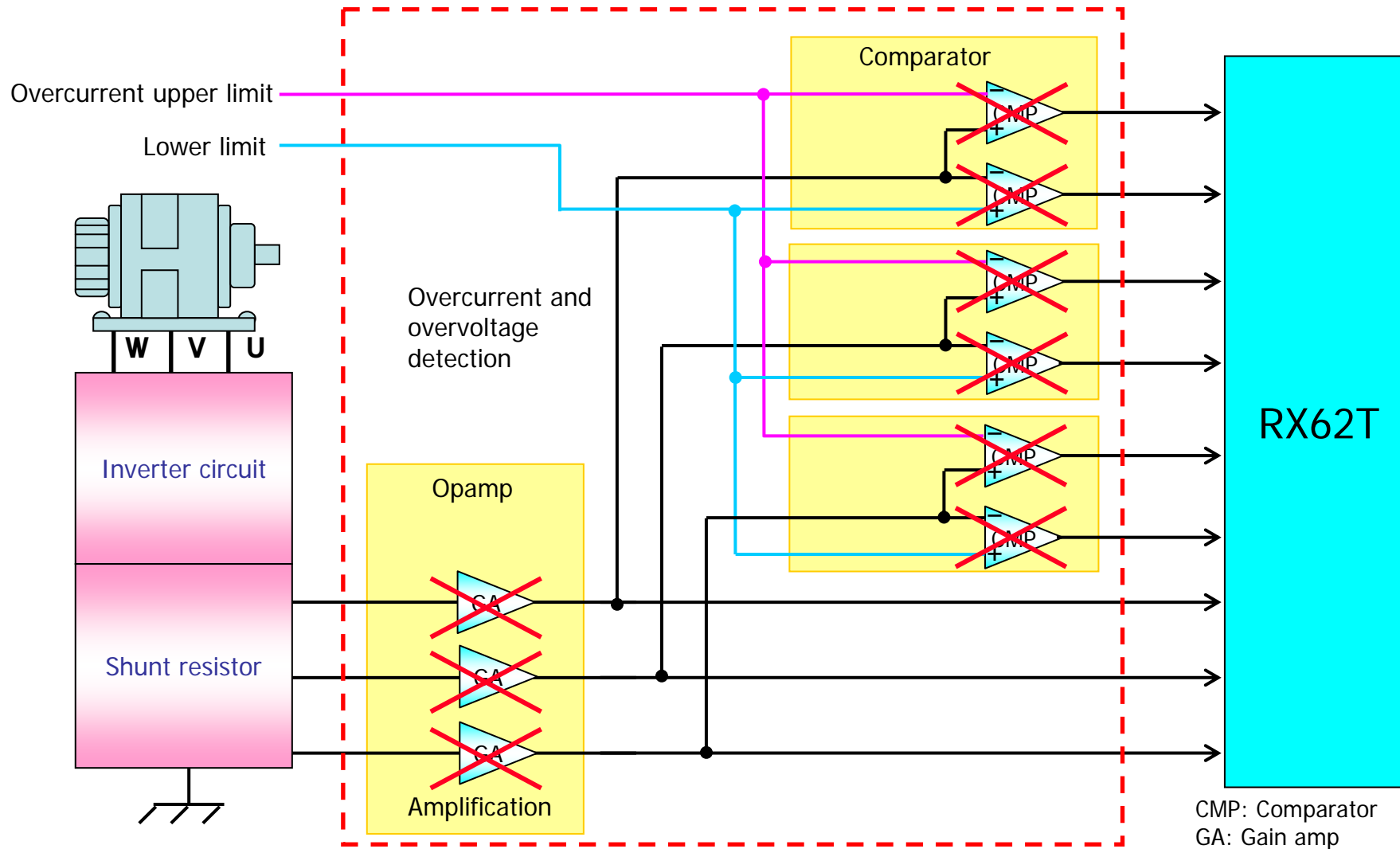
Case 2

Case 3



## ■ On-chip opamp and comparators for compact feedback control

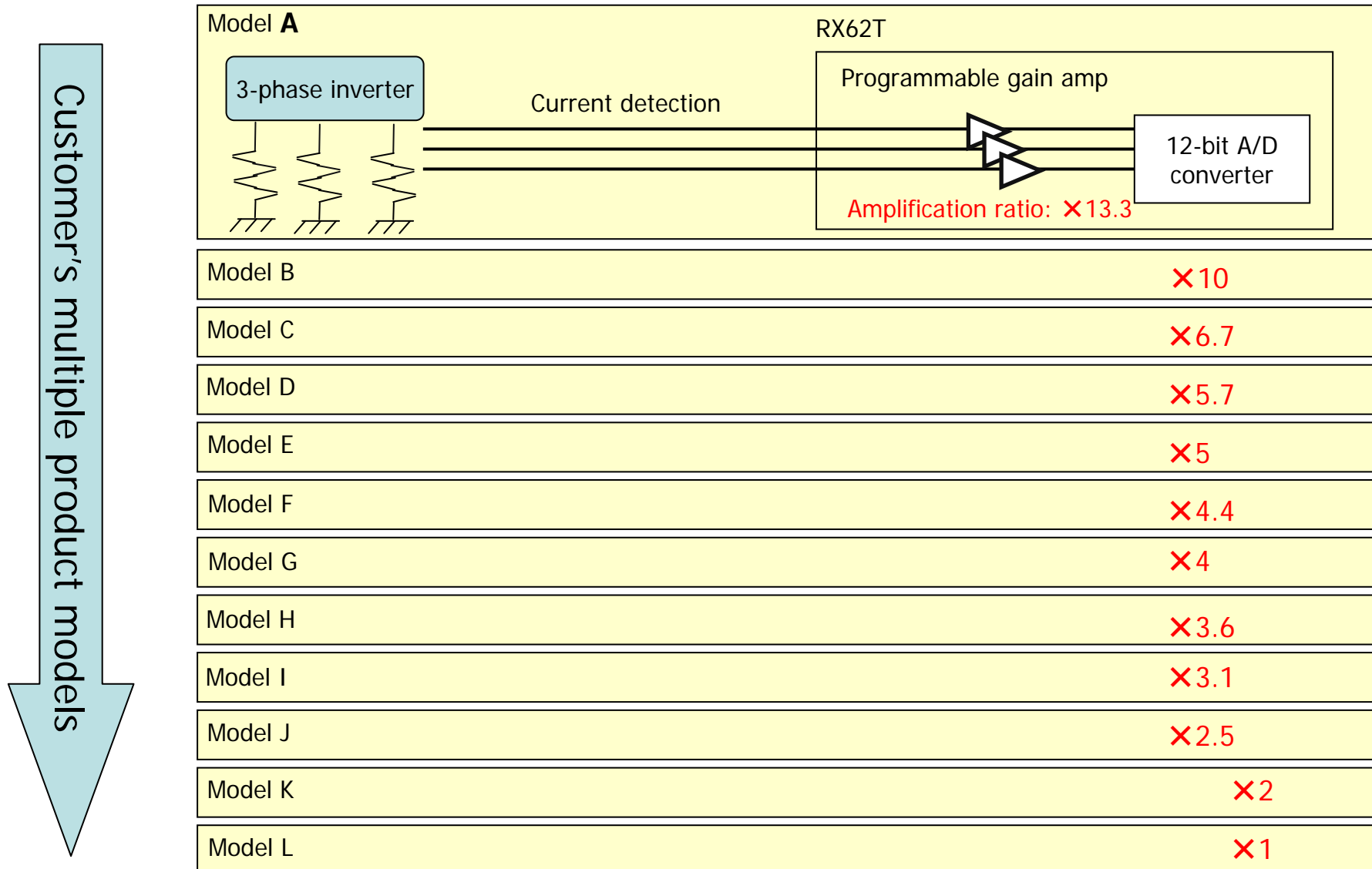
Ability to control two motors built into RX62T



# A/D Converters with Enhanced Functionality: Effect of Programmable Gain Amp

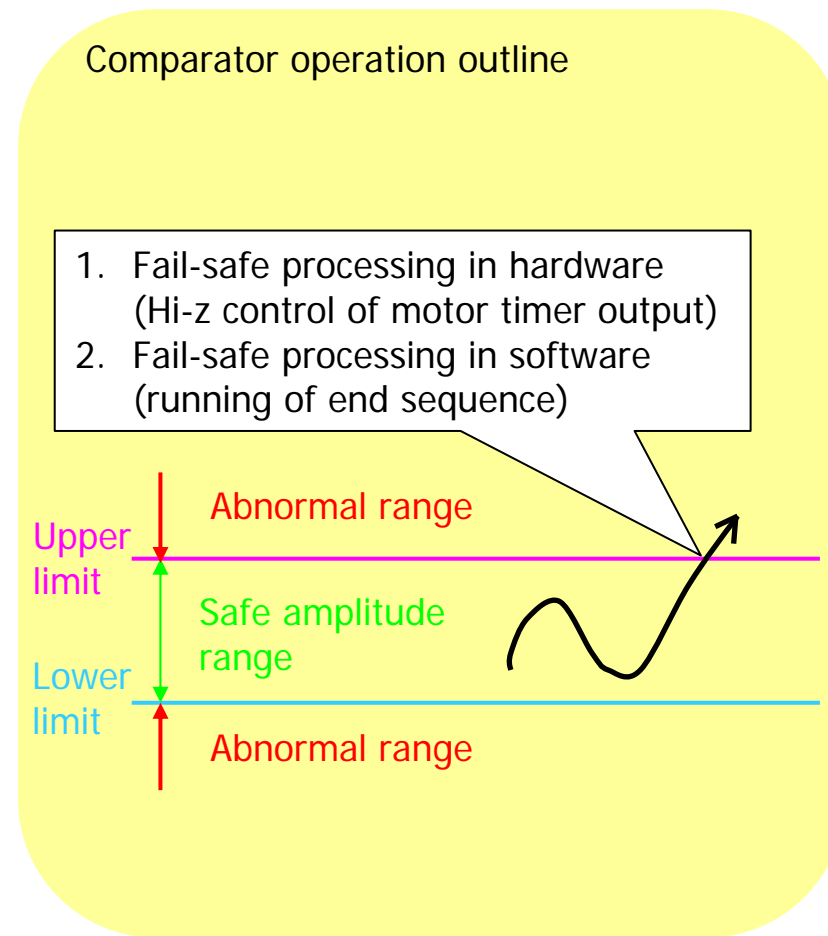
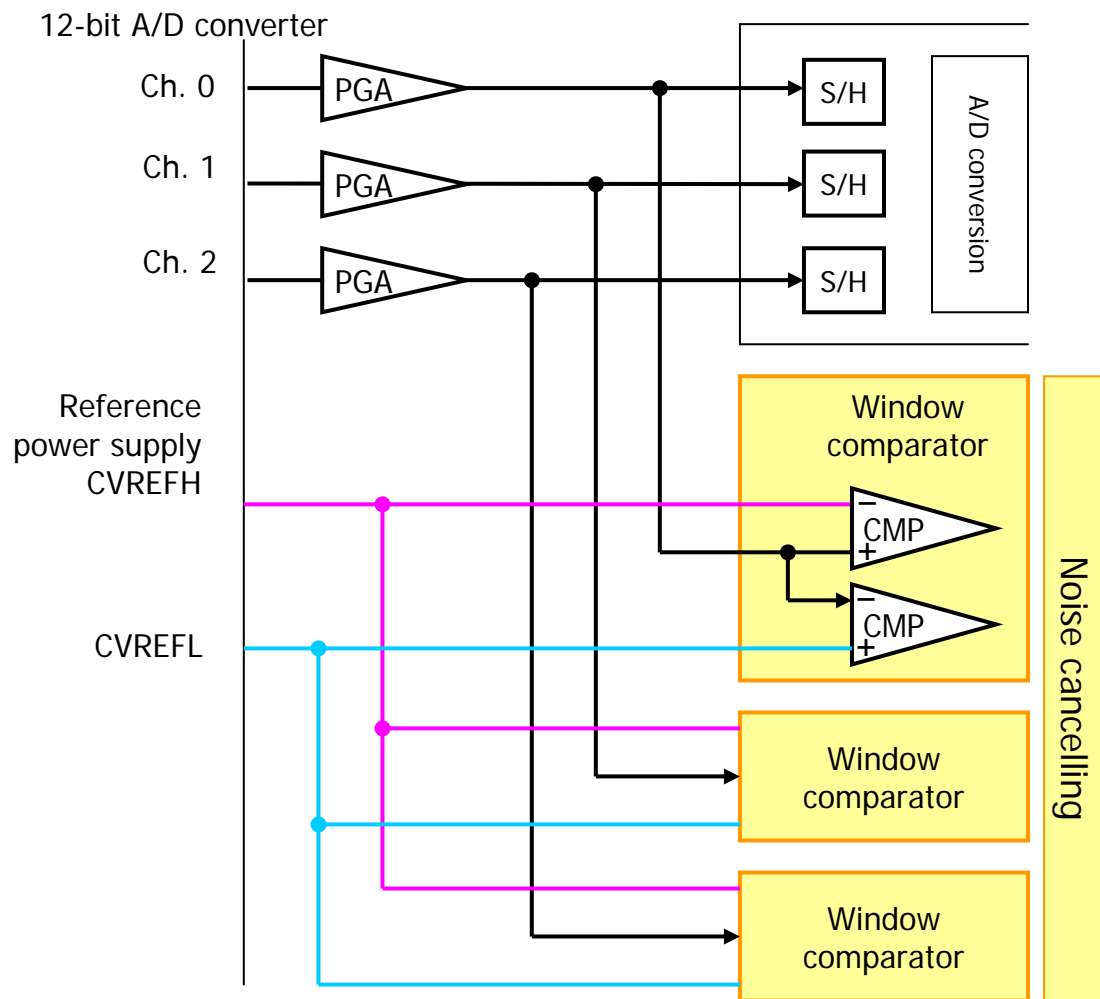


- The amplification ratio can be set in software, making it easy to roll out multiple product models.



# A/D Converters with Enhanced Functionality: Effect of Window Comparators

- Window comparators enable monitoring for abnormal current and fail-safe processing in software and hardware.



PGA: Programmable gain amp; amplification ratio: 12 levels (×1, ×2, ×2.5, ×4 and up, etc.); CMP: Comparator

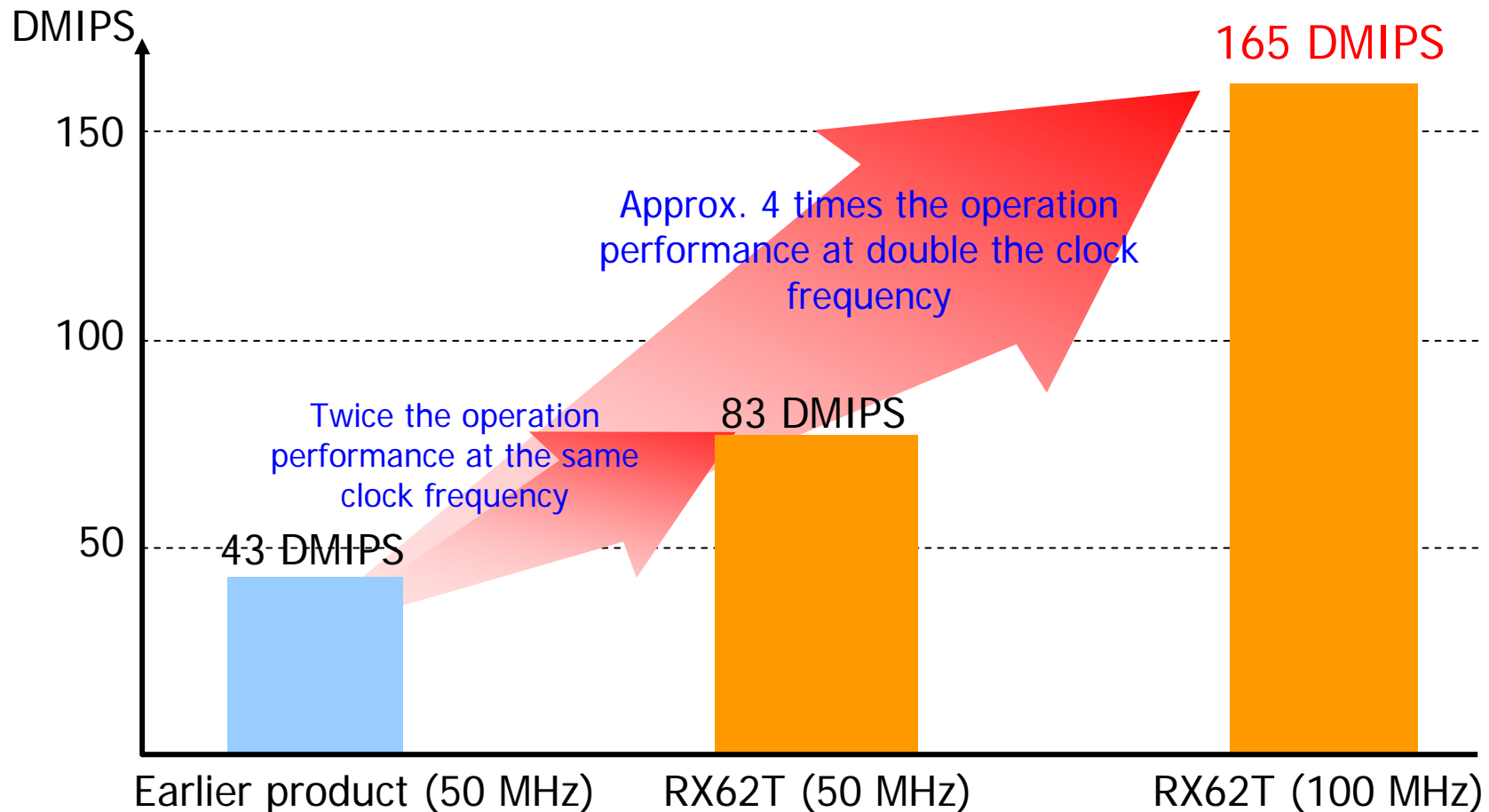
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# High-Performance RX CPU: Benchmark Tests (Dhrystone 2.1)



- Operation performance of 165 DMIPS enables highly accurate and responsive feedback control.

The RX CPU and high-speed flash memory combine to deliver **performance of 165 DMIPS** when operating at 100 MHz.

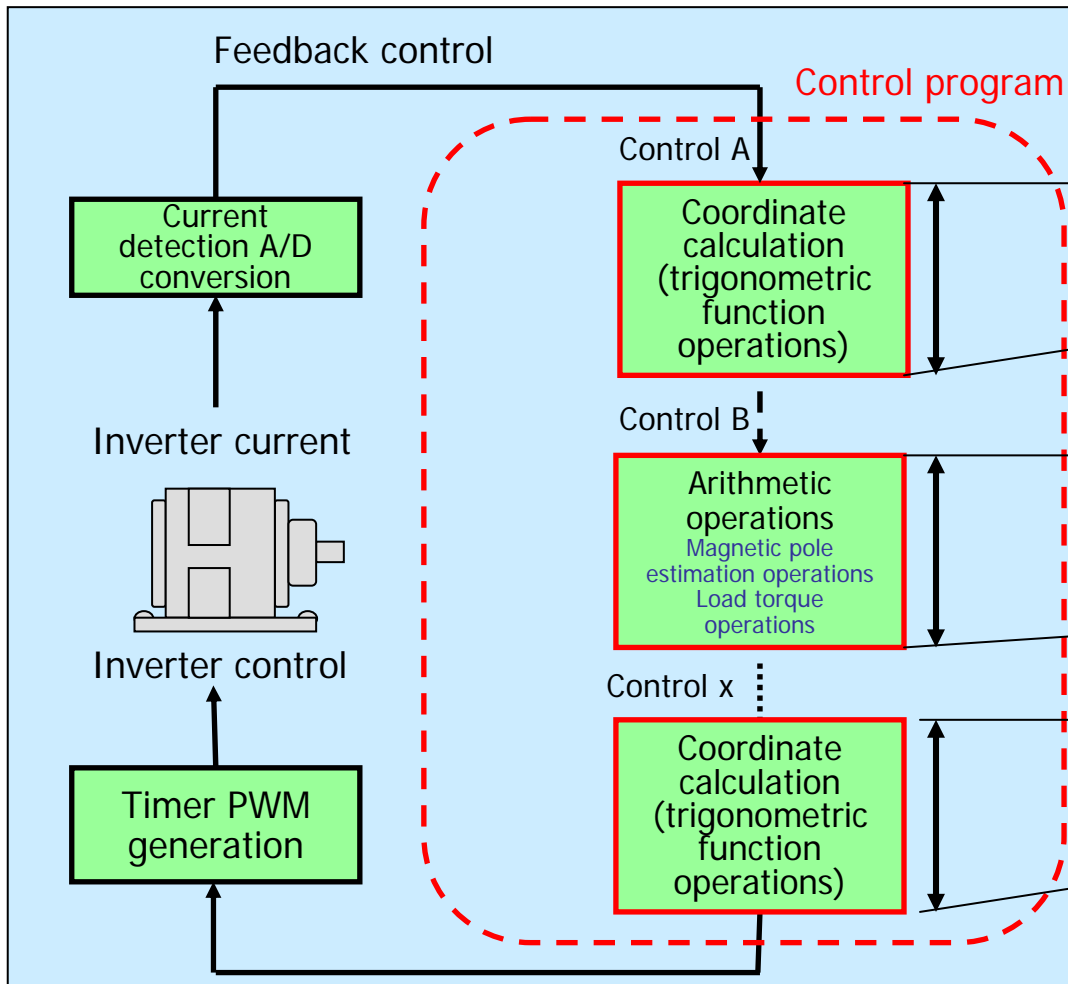


# High-Performance RX CPU: Single-Precision Floating-Point Unit (FPU)

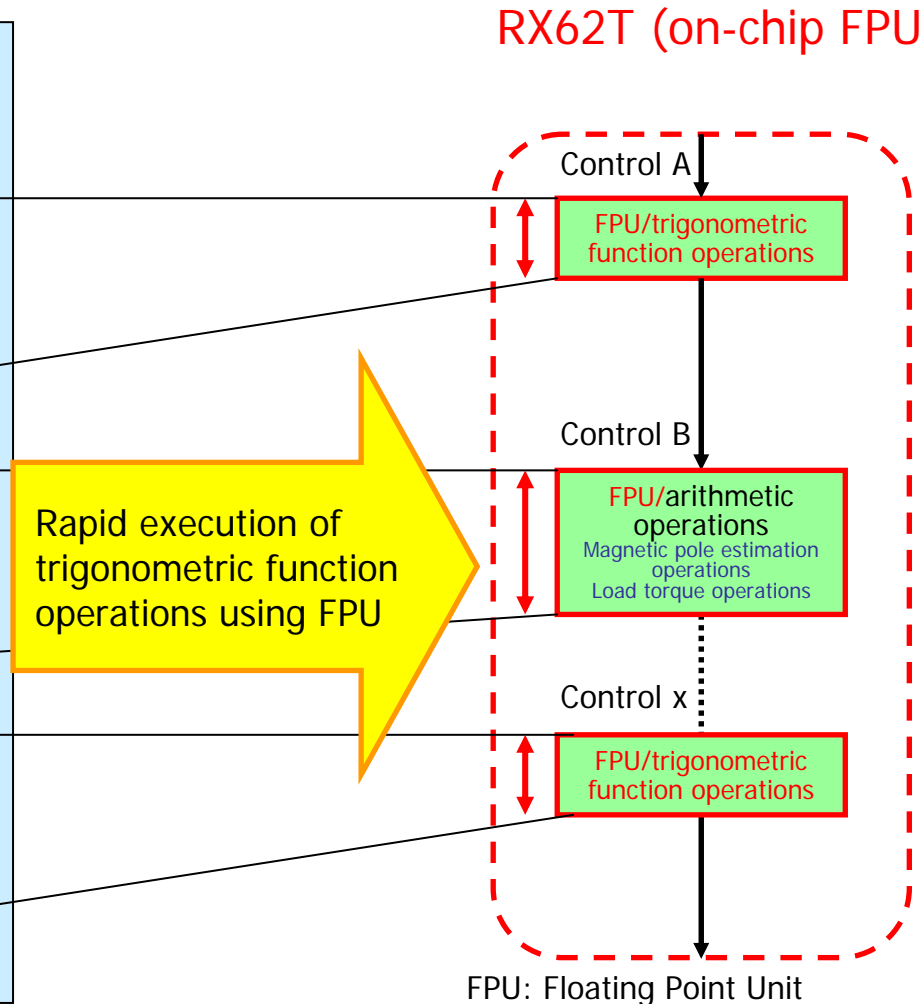


- The FPU speeds up arithmetic operations such as trigonometric function operations for feedback control that is highly accurate and responsive.

Earlier product (no FPU)



RX62T (on-chip FPU)

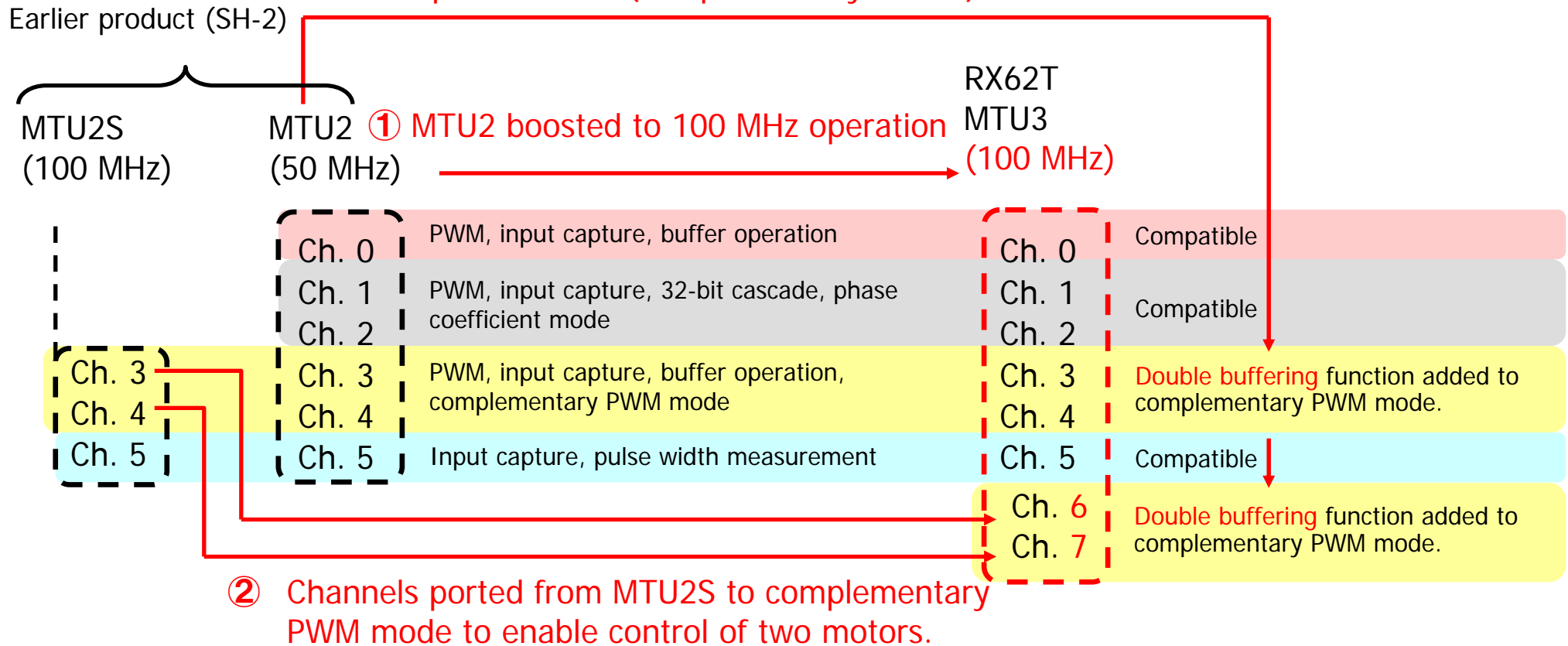


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# Timers with Enhanced Functionality: MTU3 (Enhancements to MTU2)

- Ability to control 2 motors using PWM with 100 MHz resolution  
 ⇒ Highly accurate and responsive feedback control

## ③ Improved PWM (complementary PWM\*) for motor control



\* PWM with dead time for inverter control

# Timers with Enhanced Functionality: Effect of MTU3 and Double Buffering

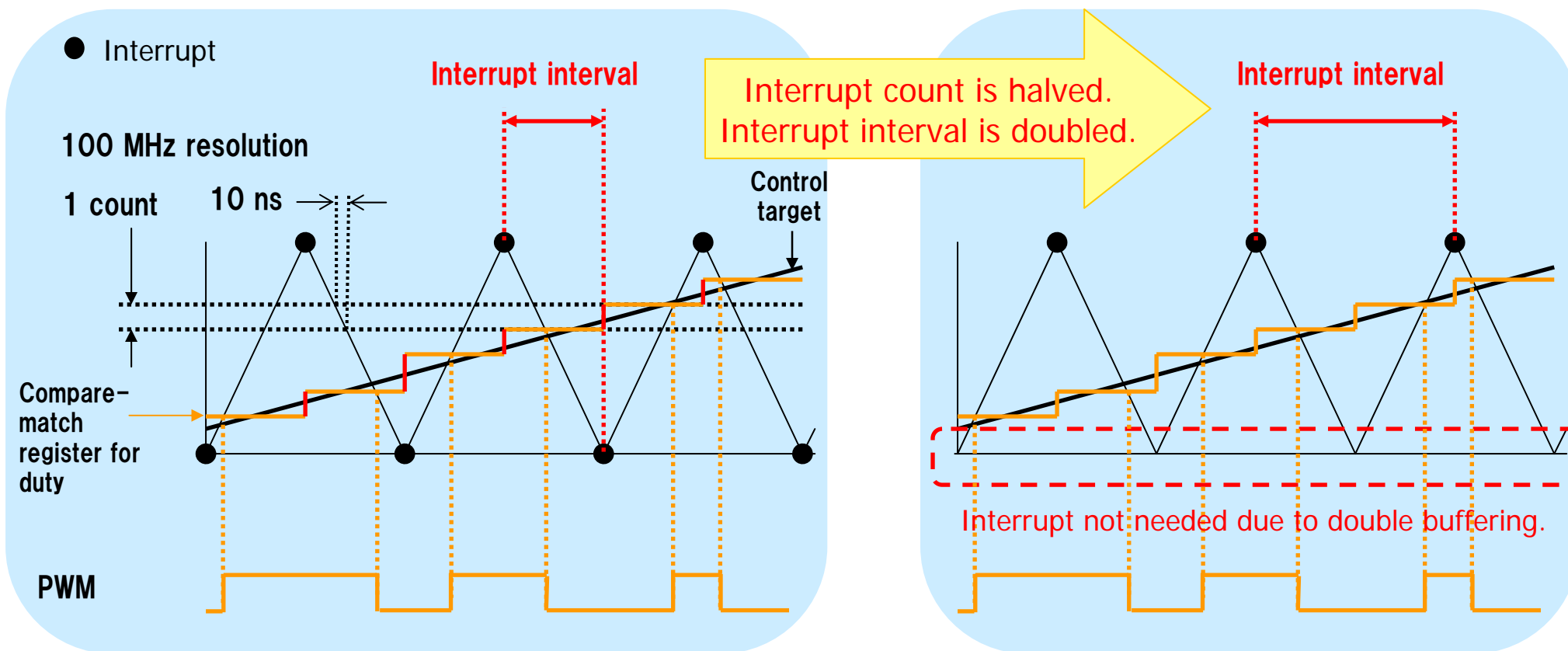
■ The double buffering function reduces the software load.

## Earlier product (MTU2S)

Up-counter compare-match setting at peak interrupt  
Down-counter compare-match setting at trough interrupt

## RX62T (MTU3)

Compare-match setting of up- and down-counters can be accomplished using peak (or trough) interrupt only.



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# Other Features

Improved motor control functions

- Incorporation of peripheral components (programmable gain amp, window comparators)
- Enhanced A/D functionality (dual 12-bit A/D units, 3 S/H circuits, double data registers)
- Enhanced timers (higher PWM resolution, timer start by comparator)

High speed and high performance

- Code efficiency among best in industry (30% improvement over earlier Renesas products)
- High-speed operation and performance of 165 MIPS at 100 MHz
- Hardware multiplier/divider, MAC, and single-precision FPU

High-speed on-chip memory  
On-chip data flash

- High-speed memory with single-cycle access at 100 MHz (flash: 256 KB, RAM: 16 KB)
- Data flash: 8 KB (30,000 E/W cycles, 2 KB × 4 blocks)

Reduced current consumption

- Low current consumption of 50 mA when operating at of 100 MHz
- Low-current (power-down) modes selectable to match usage state (sleep, all module stop, software standby, deep software standby)

Communication I/F functions

- SCI (clock synchronous /UART with noise cancelling) × 3 ch.
- I<sup>2</sup>C, LIN, and CAN: 1 channel each

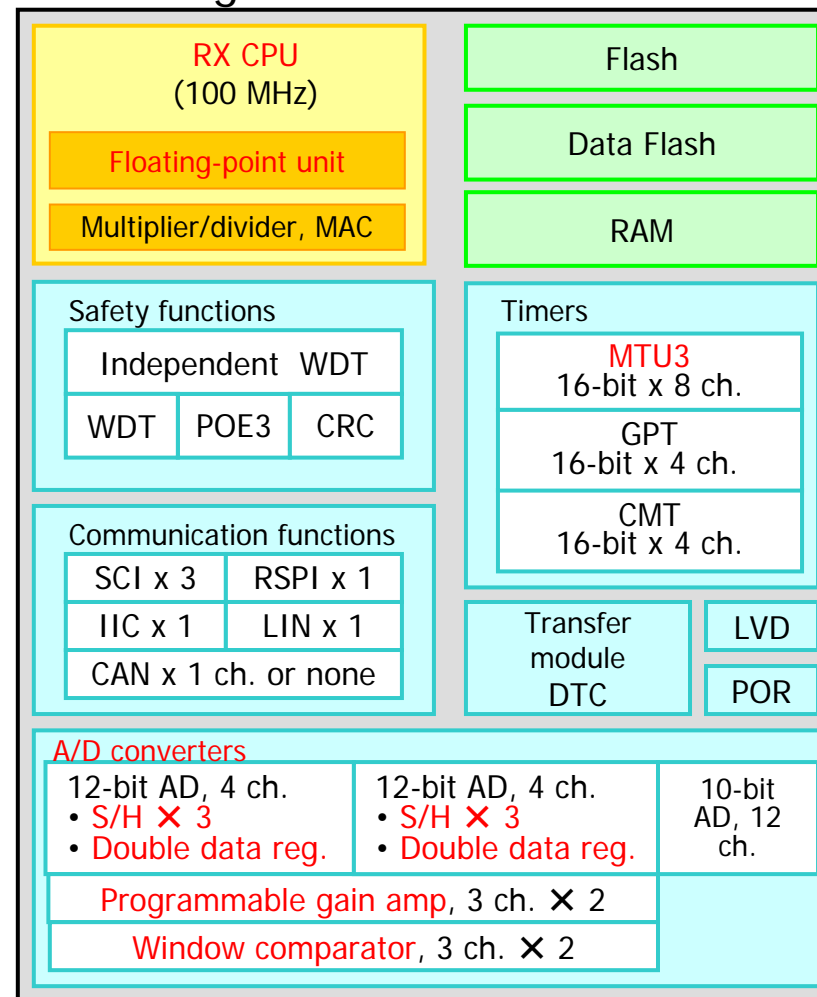
Easy-to-use tools with advanced functions

- On-chip debugger for easy debugging (E1)
- On-chip debugger with trace function (E20)
- Debugging without taking up user pins (debugging MCU board)

# RX62T Group Overview of Specifications

- **High-performance RX CPU**
  - Max. operating frequency: 100 MHz (1.65 MIPS/MHz)
  - **Single-precision floating-point unit**, multiplier/divider, multiply-and-accumulate unit (MAC instruction)
- Power supply voltage: 5 V single (4.0 to 5.5 V), 3.3 V single (3.0 to 3.6 V)
- On-chip memory:
  - Flash: 256/128/64 KB
  - RAM: 16/8/8 KB
  - Data flash 8/8/8 KB (30,000 E/W cycles, erase size: 2 KB)
- Power consumption: 50 mA/100 MHz (typ.)
- Featured functions
  - PWM timer
  - 2-motor 100 MHz control (**MTU3**), support for start by comparator (GPT)
  - **12-bit A/D converter**  
Conversion time: 1  $\mu$ s  
**S/H circuit X 3**: Support for simultaneous sampling on 3 channels (3-shunt control)  
**Double data registers**: Support for continuous sampling on 1 channel (single-shunt control)  
**Programmable gain amp**  
**Window comparators**
  - Improvements to communication functions  
Noise canceller (SCI/UART)  
High-speed communication at 12.5 Mbps (RSPI/clock synchronous serial)
  - Safety functions  
Timer output active level monitoring and Hi-z control (POE3)  
Independent WDT using dedicated on-chip oscillator  
Self check function: Oscillation stop, abnormal oscillation, A/D converter and port output
  - Other  
Data transfer controller (DTC): Variable PWM period and duty  
Voltage setting: Ability to set digital power supply to 3.3 V and analog power supply to 5 V
- Development environment: E20 and E1 on-chip debugging emulators
- Package: LQFP112/LQFP100/LQFP80/LQFP64

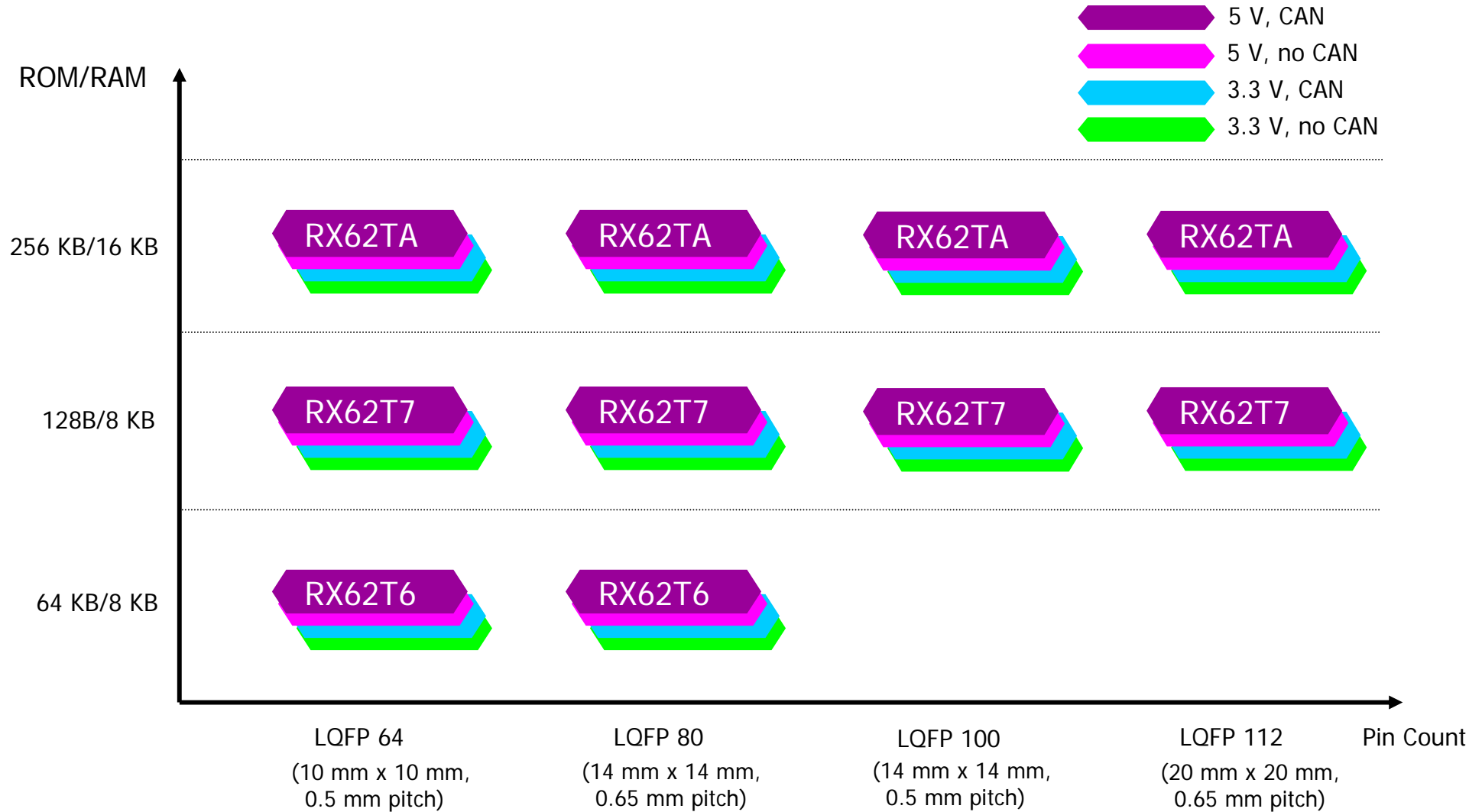
## Block diagram



# RX62T Group Lineup



■ Various memory, package, and voltage combinations for a total of 12 product types with 40 versions



# RX62T Lineup



■ Lineup of 3 V and 5 V versions, each with four pin counts

			RX62T									
Pin count			112		100		80			64		
Operating voltage	5 V version	Digital power supply	4.0 to 5.5 V		4.0 to 5.5 V		4.0 to 5.5 V			4.0 to 5.5 V		
		Analog power supply										
	3 V version	Digital power supply	2.7 to 3.6 V		2.7 to 3.6 V		2.7 to 3.6 V			2.7 to 3.6 V		
Analog power supply		3.0 to 3.6 V, 4.0 to 5.5 V		3.0 to 3.6 V, 4.0 to 5.5 V		3.0 to 3.6 V, 4.0 to 5.5 V			3.0 to 3.6 V, 4.0 to 5.5 V			
Frequency	CPU, MTU3, GPT		100 MHz		100 MHz		100 MHz			100 MHz		
	Peripheral		50 MHz		50 MHz		50 MHz			50 MHz		
ROM			256 KB	128 KB	256 KB	128 KB	256 KB	128 KB	64 KB	256 KB	128 KB	64 KB
RAM			16 KB	8 KB	16 KB	8 KB	16 KB	8 KB	8 KB	16 KB	8 KB	8 KB
FPU			○		○		○			○		
Peripheral functions	16-bit timer		16 ch.		16 ch.		16 ch.			16 ch.		
	3-phase PWM with dead time		2 ch. (MTU3) + 1 ch. (GPT)		2 ch. (MTU3) + 1 ch. (GPT)		1 ch. (MTU3)			1 ch. (MTU3)		
	12-bit AD/10-bit AD		4 ch.+4 ch./12 ch.		4 ch.+4 ch./12 ch.		4 ch.+4 ch./4 ch.			4 ch.+4 ch./—		
	SCI/RSPI/IIC/LIN/CAN		3 ch./1 ch./1 ch./1 ch./1 ch.		3 ch./1 ch./1 ch./1 ch./1 ch.		3 ch./1 ch./1 ch./1 ch./1 ch.			3 ch./1 ch./1 ch./1 ch./1 ch.		
	Programmable gain amp		3 ch. x 2		3 ch. x 2		3 ch. x 2			3 ch. x 2		
	Comparator		3 ch. x 2		3 ch. x 2		3 ch. x 2			3 ch. x 2		
	POR/LVD		○/○		○/○		○/○			○/○		
Low-power modes	Sleep, all module stop, software standby, deep software standby		○		○		○			○		
Package			LQFP112 (20 x 20 mm, 0.65 mm pitch)		LQFP100 (14 x 14 mm, 0.5 mm pitch)		LQFP80 (14 x 14 mm, 0.65 mm pitch)			LQFP64 (10 x 10 mm, 0.5 mm pitch)		

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# Summary



- The RX62T Group is the third release of products in the RX Family.
- The timer and A/D converter functions have been enhanced, more advanced and accurate inverter control implemented, and the software load reduced.
- On-chip programmable gain amp and window comparators have been implemented, contributing to reduced system cost for customers.
- Sample schedule  
Sample shipments will begin in March 2010 in Japan and the various versions will be introduced successively.
- Mass production schedule: RX62T Group
  - Start of mass production: December 2010, 100,000 units/month
  - Stable period: 2012, 1 million units/month



Note: Product names, company names, or brands mentioned are the property of their respective owners.

**Renesas Technology Corp.**

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